

SCIENCE VOCABULARY AND ELL STUDENTS: A QUALITATIVE STUDY

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Abstract

Vocabulary acquisition is a multi-faceted process in any language. Truly knowing a word is incredibly complex in nature (Richards, 1976). When two of my ELL students appeared unengaged in science, I questioned the role of scientific vocabulary in their ability to participate. Specifically, how did academic science vocabulary affect mastery of third grade science concepts for my two third grade ELL students? Though primarily a qualitative study, data was collected through mixed methods of observations, interviews, and assessments. Results revealed factors besides vocabulary to consider, such as learning preferences, scholastic background, family involvement, and having basic needs met. While academic content vocabulary is a gap to be filled for ELL students, there may be deeper issues and needs to be met first.

Science Vocabulary and ELL Students: A Qualitative Study

During a science lesson from the Rocks and Minerals unit in my third grade classroom, I noticed that two of my English Language Learners (ELLs) were completely disengaged. One of them was off task by leaving his group and having conversations about other topics while the other was simply not participating in the work her group was doing. When I considered why this might be, I suddenly found myself wondering if they actually understood what was going on around them. I realized they likely come from backgrounds with varying degrees of scientific knowledge and vocabulary which may be inhibiting them from actively participating. Even if they wanted to engage, they may not be able to formulate appropriate questions or responses in English. Also, even though one of the students possesses fairly strong English skills, he may not have acquired the necessary academic science vocabulary from the FOSS science curriculum that his peers have been exposed to since Kindergarten.

In this research project, I will focus on these two ELL students and examine the correlation between their abilities to learn science content and the role that vocabulary plays in this. Thus, my research question is:

- How does academic science vocabulary affect mastery of third grade science concepts from the FOSS science curriculum for my two third grade ELL students?

Vocabulary acquisition is a multi-faceted process in any language. Just to “know” a word is incredibly complex (Richards, 1976). This strengthens my reason to believe that knowledge of specific content area vocabulary affects an ELL student’s

ability to successfully master grade level expectations within that content area. Learning English is difficult enough for many non-native speakers but then to expect an additional level of knowledge within an academic subject adds another layer of complexity. On top of this, my ELL students likely have varying levels of previous experience with science in general. They have both come from different schools and one of them attended school in a different state. Transferring to a new school may have caused learning gaps not only in scientific vocabulary but in scientific concepts as well.

Literature Review

Successful language acquisition for students who are English Language Learners (ELLs) is a topic that has inspired many different research studies over the years. According to the National Education Association, “The term English Language Learner (ELL) indicates a person who is in the process of acquiring the English language and whose first language is not English” (Diversity Toolkit: English Language Learners (ELLs)). As the ELL population in public education increases annually at a rapid rate, researchers continue to study the process of learning and teaching a new language to students. While there is some debate as to which methods and pedagogical practices are most effective for ELLs, one common theme emerges amongst researchers. This common theme is the importance of vocabulary as part of a student’s education. In her article that discusses how to effectively incorporate vocabulary instruction into science lessons, Young (2005) concludes,

When students understand the language of their science subjects, they are well on their way to content literacy mastery (i.e., being able to read, write, speak, listen,

and effectively communicate content knowledge with a high degree of competency and expertise) (p.15).

This review will explore the implications of this theme as well as how it specifically relates to teaching academic science vocabulary to ELL students.

CALP and BICS

In the ELL world, J. Cummins (1980) is well-known for his theories of English language acquisition and an important dichotomy involved in the process. He argues that the language acquisition process includes learning both content-specific academic language and basic communication skills, which are not necessarily dependent on one another. These two components are now commonly referred to as CALP and BICS.

Cummins (1980) writes,

I prefer to use the term cognitive/academic language proficiency (CALP) in place of Oller's global language proficiency. CALP is defined as those aspects of language proficiency which are closely related to the development of literacy skills in L1 and L2. Basic interpersonal communicative skills (BICS) in L1 such as accent, oral fluency, and sociolinguistic competence may be independent of CALP for a variety of reasons and it is not being suggested that these latter skills represent a unitary dimension. For example, some of these linguistic skills are presumably universal across native speakers (e.g. phonology, basic competence in a Chomskian sense), while individual differences in others appear to be unrelated to cognitive and academic skills (e.g., oral fluency) (p. 177).

This concept explains why there it is easy to assume that ELL students are more proficient in English than they actually are. Since BICS concern an ELL student's survival skills, it stands to reason that these are the skills that develop first and most rapidly. An example of this is someone traveling to a foreign country and wanting to learn how to ask for a bathroom in the country's native language. Since this phrase is important for survival, it is more critical for the traveler to learn than how to discuss something like scientific theories with native speakers. It also stands to reason that after one's BICS are further developed, he or she can begin to develop his or her CALP as survival becomes less of an immediate concern. While this is a logical procession of development, the issue for many ELL students is that there is often a large gap between the two and that teachers don't necessarily consider that a highly developed set of BICS is not an indicator of a student's CALP. These are two different parts of language development and should be treated as such.

Teaching Academic Science Vocabulary

According to Fradd and Lee (1999), "Learning science is dependent on students' ability to comprehend and communicate concepts and under-standings. The instructional process is complex, particularly when it involves developing language proficiency and literacy along with content knowledge" (p.16). A recent qualitative study conducted by De La Colina and Cuellar (2011), was based on the self-reflection of teacher participants in bilingual Spanish/English schools and in what ways they felt less than adequate in providing bilingual support to students when teaching science. Interestingly enough, most of these teachers reported feeling that they were lacking in knowledge of academic

science terms in Spanish (the language they were teaching in) and saw it as a possible contributing factor to students' low state standardized test scores in Science. One of the problems identified in this study was that, though nearly all of the teachers were native Spanish-speakers, many of them had learned different words to describe the same scientific objects or concepts and had been teaching them to their students. This would be similar to using the terms "petri plate," "cell culture dish," or "petri dish" in English to describe the same object. This case of inconsistency is a great example of the importance of purposefully teaching English academic science vocabulary to ELL students so that they can have a good basis to build upon as they progress through science during their school careers.

Academic Science Vocabulary and Inquiry

In addition to creating a solid baseline for learning, a strong vocabulary can also help students develop scientific skills. A study by Fradd & Lee (1999) sought best methods for teaching science inquiry to students with diverse language backgrounds. From this study, a connection was drawn between science vocabulary and inquiry. Again, the importance of science vocabulary is clear:

Students with little science knowledge and vocabulary produced the least amount of language and were the least aware of how to use cognitive strategies... Students with comprehensive science knowledge and vocabulary often used a moderate amount of language, spoke precisely using specific vocabulary, and used strategies related to the tasks (p.17).

Here, science vocabulary is proven to be a building block for students to be successful with science inquiry. Further, the students in this study with higher levels of comprehensive scientific knowledge showed similar ability levels to students who were natural English speakers. This study clearly demonstrated that a student's vocabulary has the ability to either limit or enhance his or her inquiry skills.

Academic Vocabulary and Comprehension

Similarly, academic vocabulary knowledge has been shown to affect comprehension (Carlo et al., 2004; Cunningham and Moore, 1993). Cunningham and Moore (1993) showed that "academic vocabulary in comprehension questions significantly decreased question-answering performance" (p. 171). While this study specifically focused on academic vocabulary and comprehension in reading/language arts, there is reason to believe that the same relationship exists in other academic content areas. Further, since these results include non-ELL students who already know English and have been exposed to the vocabulary, then they must also be true for ELL students.

In fact, a low level of comprehension stemming from a lack of vocabulary knowledge has further implications for ELLs when compared to their English Only (EO) classmates. Commonly,

ELLs who experience slow vocabulary development are less able to comprehend text at grade level than their EO peers, and they may be at risk of being diagnosed as learning disabled, when in fact their limitation is due to limited English vocabulary and poor comprehension that results in part from this limitation (August, Carlo, & Snow, 2005).

These ELL students likely have gaps in vocabulary knowledge that need to be addressed, but instead, many are considered to be students with special needs which still does not guarantee that these gaps will be filled. This is another clear example of just how key vocabulary knowledge and acquisition are to the success of an ELL student. Obviously, this is a problem that could be addressed through explicit vocabulary instruction.

Effective Vocabulary Instruction

While it may sound like a simple solution, effectively teaching and learning vocabulary in any content area is a complex process (Carlo et al., 2004). An intensive vocabulary program created by the researchers was implemented to test the effectiveness of an intervention program that introduced multiple word acquisition and comprehension strategies to ELL students. Students participating in this study underwent an intensive curriculum where they were not only taught the new words themselves but they also learned important skills for encountering new unknown words. This multi-faceted approach in itself shows the complexity of the depth required to truly know a word. Then, to ensure student knowledge of the newly acquired vocabulary, students were given the following six assessments: the Peabody Picture Vocabulary Test Revised (to assess word association with images), a polysemy production test, a multiple-choice reading comprehension test, a multiple-choice word mastery test, a word association task, and a test that measured student knowledge of English morphology. What is important about this study is that the results showed a strong positive correlation between the intervention program and the overall growth of word knowledge from students in the test group. It was confirmed that the techniques used in the intervention program, which

implemented previously successful methods (Beck, McKeown, & Omanson, (1987), were actually effective for both ELL and English Only (EO) students. What is also interesting to note is that additional results also showed a slight increase in reading comprehension for the test group though the effect size was much smaller.

While a strategically designed curriculum has clearly proven to be very effective when executed well, frequency alone was confirmed as the dominant factor in a student's ability to learn vocabulary (McKeown, Beck, Omanson, & Pople, 1985) (August, Carlo, Dressler, and Snow, 2005). In these studies, frequency referred to the number of times a student was exposed to a vocabulary word within a given amount of time. That being said, a truly effective vocabulary curriculum should focus partially on frequency of exposure to word in addition to rich instruction. Frequency alone has been proven to increase a student's depth of knowledge due to the evolution of a student's thought process from each encounter (August et al., 2005).

Learning a word requires learning (over a series of encounters) these various aspects of its meaning, and inferring word meaning from context can also require being alert to these various aspects; a first encounter with a word might, for example, provide information about syntactic word class and some very general specification of meaning domain, whereas subsequent encounters will expand the semantic specification and may lead to discovery of polysemous possibilities. Thus, subsequent encounters build *depth* of word knowledge, which is as important in using words as is the more commonly assessed *breadth* (p. 59).

Students are best able to reach this point of depth when provided with at least 12 encounters of a word while also receiving, “rich instruction presenting elaborated word meanings and diverse contexts, or extended/rich instruction which added activities to extend use of learned words beyond the classroom” (McKeown et al., 1985).

Summary

To summarize, vocabulary is a critical piece of an ELL student’s success in education. Specifically, an ELL student’s CALP in science has heavy implications for his or her comprehension, scientific inquiry abilities, strategies for solving unknown words, etc. It is important to remember that BICS and CALP are not dependent upon one another and so a student with highly developed BICS is often mistaken for having the same level of CALP. Additionally, because many ELL students lack English vocabulary in general, they are often labeled as having special needs. Even if these students are provided special education, there is no guarantee that the necessary academic vocabulary will be taught to them. This leaves the job up to the classroom teacher. However, adequately providing vocabulary instruction requires a great deal of time from both teachers and students. In order to implement a successful vocabulary program, it must be well-designed, multi-faceted, and ensure a high rate of frequency for students’ encounters with the vocabulary. This also means that teachers would have to provide specialized vocabulary sessions in addition to the regular content area matter that is taught. While it may seem like a daunting task, it is hard to argue with something that has such a positive effect on so many students. Whether or not it is the solution, the lack of English vocabulary that many ELL students face is a crucial issue that needs to be addressed.

Methodology

Research Design and Rationale

For my research, I used primarily qualitative methods as I only have a small population of ELL students in my third grade classroom. This research was largely based on a two student case study which allowed me to gather data specific to these students since the purpose was to gain an insight into their personal experiences with third grade science. For this unit, I introduced a cognitive content dictionary to the whole class in the hopes that it would strengthen overall scientific competency for my students. In addition, I also collected a small amount of data quantitatively so that I could assess these students for scientific content knowledge at the end of the research process. This consisted of analyzing their Measurement test scores at the end of the unit to see if they had meet grade level expectations.

Sampling Procedures

My research was based on my third grade classroom at an elementary school near a major city in Washington. The school is located in a suburban neighborhood just a few miles away from downtown. Socioeconomically speaking, the school consists of great diversity from extremely wealthy to extremely impoverished families with everything in between. The location was chosen due to convenience and time constraints, as it is where I am currently working.

I used purposive sampling based on ELL students from my classroom. This is due to the fact that I specifically targeted ELL students and there are very few of them in the class. I have the most ELL students of the third grade teachers and they are also at

varying levels with regards to English language proficiency, which I hoped would give me a broader range of data. I sent home consent forms to the parents of both students to ensure that the students could participate in my research.

Sample. The sample for this project consisted of two nine-year-old students from my third grade class. One of the students is female and the other is male. Each student is a native speaker of a different language and each is at a different level as an ELL student. They are both mainstreamed in my classroom full-time.

Juana. Juana is a female student in my class. She transferred from a school in Des Moines, Washington to our school in mid-October. Her first language is Spanish, which is what her family speaks at home. Though born in the U.S.A., she requires ELL intervention and additional support in nearly all academic areas. She is consistently testing below grade level expectations in all academic areas and scarcely speaks in class. She is also incredibly shy.

Elias. Elias is a male student in my class. He was born in the United States and primarily speaks Amharic. His earliest years were spent in Texas and then his family moved to Washington a few years ago. This is his first year at our school. He has made many friends since the beginning of the year and gets along well with his classmates. At the beginning of the year, he was tested for ELL services but did not qualify. Currently, he is testing below or approaching grade level expectations in all academic areas.

Potential Threats to Validity

The fact that I conducted this research with students in my own classroom presented potential threats of researcher bias and data collection bias to internal validity.

In order to avoid these biases to the best of my ability, I asked other teachers to help me with collecting some of the data. For example, I asked a fellow teacher to observe my ELL students while I am taught science to see what they noticed. I then combined this with my own observations to gain a more well-rounded perspective. Also, I asked one of my third grade teammates to grade my ELL students' science assessments so that I can avoid bias through grading. Finally, I requested assessment data from the ELL Specialist at my school in order to avoid bias through assessment. Once I obtained all of the data, I had to be very careful in the process of coding and analyzing so as to avoid further bias.

Data Collection Methods

Primarily, I collected qualitative data through observations and interviews with these two students. During the science lessons in this unit, I observed and took notes for approximately ten minute segments over the course of ten days. Students were also observed for approximately 15 minutes by a fellow teacher during a science lesson that coincided with this study. Additionally, I utilized the school district's common Measurement – Content Assessment (see Appendix A), which accompanied the third grade FOSS Science curriculum for the Measurement unit. This assessment was content-based and consisted of multiple choice and short answer items. The test was given to students on the last day of the unit during one 70-minute period. After the students finished, I asked a fellow third grade teacher to grade this assessment for Juana and Elias and base it off of the school district's third grade Content Assessment Scoring Guide (see Appendix B). Shortly after the unit, I spent approximately 10 minutes with each student conducting an interview consisting of 11 questions (see Science & ELL: Interview

Questions, Appendix C). Also, I used the English as an Additional Language (EAL) Listening & Speaking Continuum created by Bonnie Campbell Hill (2001) (see Appendix D) to determine students' relative levels of English proficiency at the beginning of the study. This information was provided by the ELL Specialist at my school. She observed a non-related lesson during the time of this study for approximately 20 minutes and provided me with a current continuum for both Elias and Juana.

Data Analysis Methods

There were several methods involved in the analysis of data collected from my research. Primarily, I used coding when examining data collected from observations and interviews. Here, I looked for themes to emerge, few of which aligned with my presuppositions. For the FOSS Science assessment, I relied on the evaluation given by my third grade coworker, which I compared to the rubric used to measure a student's knowledge of that specific science unit. That helped me to see if the students were meeting the third grade science objectives for content mastery. In order to place students on the Bonnie Campbell Hill continuum, I asked for the help of our school's ELL Specialist to collect the data during classroom observations and interpret individual student standing.

Results/Discussion

Observations

Results. As I gave the signal, my third grade students eagerly rotated to their first reading activities of our usual morning routines. Today, we would begin our new science unit called, "Measurement," and the students were excited to take turns reading a

science story about the metric system with me on the carpet. As a class, my students are generally active and talkative, so they tend to look forward to science because they know they will have time for inquiry and experimentation. I started the unit by building background knowledge through reading a related story, which in the past has also worked to spark student interest in the topic to be covered.

On this particular morning, Elias was one of the first students to the carpet while Juana followed silently behind. The other two students from their group joined them and immediately volunteered to read aloud. I noticed that Elias was actually the first to raise his hand, which is not unusual, and I let him begin the story. He read quietly and slowly, following nearly all of the intonations and rhythms of a native English speaker. When Elias finished, Juana avoided eye contact by keeping her eyes locked on her book and allowed the rest of her group to read aloud until they were finished. She had never once volunteered to read aloud and I had not been able to convince her to read aloud for me, either.

Since this was a new topic for us as a class, I asked the group if they were familiar with the metric system or any of the words they had read about. Many of them remarked that they had heard the word “meter” before, and I watched Elias nod his head in agreement. Juana, on the other hand, followed the conversation with her eyes but did not speak. At this point, I wondered if working more with the vocabulary would help strengthen her confidence.

I pulled out a giant chart I had created for measuring length in the metric system. Then, I explained that I needed help from the group so that we could finish filling it in for

the rest of the class to use as a reference during our new science unit. Elias's face lit up as he saw the numbers for the different conversions. It suddenly occurred to me that he loves math and anything related to numbers, so I started to wonder if this unit would resonate with him based on his interests. I asked him what he noticed about the chart and he quickly shared with the group that he saw a pattern and that it, "goes by 10." The rest of his group agreed so I then asked them to help me fill in the correct term for each number. The students all began looking at the story they had just read to help fill in the chart. They were engaged and all, including Juana, began calling out the answers as I pointed to the corresponding box on the chart and fill in the missing information.

Later that afternoon, I introduced a new activity to the whole class to help them with all of the science vocabulary we would be learning in our unit. I displayed a giant cognitive content dictionary I had made out of chart paper and passed out smaller versions called, "My Measurement Dictionary" (see Appendix E) that students could keep in their desks. We looked at the first word: meter. As a class, I let students discuss what related words they knew and what the definition should be. I watched both Elias and Juana as they quietly wrote something down. When we discussed as class which words were related to meter, Elias raised his hand. When I called on him, he said, "measuring!" Many of the students agreed and I added it to our giant cognitive content dictionary so students could copy it if they needed to. We then added five new words to it, and students completed their own versions simultaneously.

During this time, both Juana and Elias appeared engaged. They were watching and following along as they copied down the various words and sentences. As I

circulated during their independent work time, I got the chance to glance at their work. I noticed that Juana's work was very hard to read. Her handwriting was small and there was little to no space between words. I was surprised that she had not related any of the vocabulary words to Spanish, as that is her native language. I also saw that she had several misspellings as well as some nonsensical words. Her misspellings included, "suben" instead of *something*, "oh" instead of *of*, and "lenth" instead of *length*. I had watched as she wrote very quickly and I noticed that she hastily stuffed her dictionary into her desk as soon as she was done writing. I found this interesting because students were given plenty of time to finish writing and they were allowed to copy as much of the class dictionary as they needed to in order to complete their charts. It became clear that Juana was even more self-conscious than I had initially thought but I also realized it could be due to a combination of a shy personality as well as insecurities about her English language proficiency.

As I moved towards Elias, I saw that he was already done with his entries and was talking to his neighbor. He is very social and well-liked by his peers, so I was not surprised. His work was sitting out so I glanced down and saw that it was also difficult to read. His handwriting was large and sloppy and there were very few words written. He had much fewer misspellings than Juana. They were also more minor, such as "measureing" for *measuring*, and "measurment" instead of *measurement*. It appeared he had rushed through his work, which is not unusual for him to do in any subject.

After students completed their dictionary entries for the day, I introduced our first experiment in which the students would develop a standard for measuring distance and

length in the metric system. Unbeknownst to them, the groups would be given straws of varying lengths. Then, each group would be asked to measure the length and width of a desk with their straws. I released the students by telling them that the “Go-Getter” from each group should grab some supplies. I heard Elias immediately tell his group, “I’ll be Go-Getter!” and jumped out of his seat to grab his group’s supplies. Elias returned and listened eagerly as he held the straws, waiting for instructions from his group. Juana, who was part of the same group as Elias, had been the last to slowly join the other students. She stood quietly behind a desk near her group, hands in her pockets. She watched her group but neither spoke nor participated.

These initial observations I made of Elias and Juana began to form patterns throughout the rest of the Measurement unit. My colleague documented very similar observations of my students when she watched one of my science lessons. Elias continued to be much more engaged and constantly volunteered to participate. He became excited over the experiments, especially as his classmates become increasingly enthusiastic. He did not ask questions but would often volunteer information and was willing to make a guess if he didn’t know the answer. His guesses, however, were often followed with, “No, no,” as he shook his head and blushed, second-guessing himself. I also noticed that he tended to stutter when he shared something aloud with the class. He participated as a member of his small group when given very explicit instructions but he never initiated or led his group in an activity. If there were written directions, he would often ask me what to do instead of trying to read them first. Typically, he was more interested in playing with the materials than using them to carry out a procedure or

experiment. He continued to be very social and was often chatting with one of his group mates instead of helping the rest of the group complete a task.

Juana's behavior was much different. She was almost always the last one to join her group during small group work time. This typically involved one of the experiments from the unit, such as filling various objects with water to learn about volume and capacity. She allowed the rest of her group to assemble and start discussing what to do as she quietly stood off to the side and listened. The group didn't seem to notice her half the time. At times, she appeared engaged and watched her group mates. Other times, she was looking around the classroom. To me, there was no observable sign or pattern as to what held her engagement and what didn't. Every once in a while, I saw her say a few words to a female group mate but each time her voice was so quiet it was inaudible from where I was standing. She did not participate in the activities unless her group mates encouraged her to perform a specific task. She avoided eye contact during whole class lessons and discussions and never raised her hand.

I did, however, have two very interesting conversations with Juana outside of science. One was a few days into the Measurement unit when she returned to the classroom right after school. She came in to grab her backpack in a huff and told me, clearly annoyed, that she did not have a good time at Lunch Bunch. Lunch Bunch is provided by our ELL Specialist and is a 30-minute period of ELL services she receives three times per week with two other third grade native Spanish speakers. This was one of the first times Juana had voluntarily spoken to me, so I was surprised. When I asked her what happened, she explained she had experienced difficulty making a sentence when it

was her turn to do so. I asked what the sentence had been but she said she couldn't remember. Just then, the two other girls from Lunch Bunch peeked in and started giggling when they saw Juana. I asked Juana if her feelings were hurt and she said no and smiled at the other girls. One of them poked her head in and said, "She couldn't say 'enchilada' in Spanish!" All three girls started laughing at this point. Juana then went on to tell me that she had started school speaking Spanish only but attended an English-only Kindergarten. She told me it was difficult because she had to learn English for the first time. Then, I asked if she learned how to read in Spanish or English first. She did not answer but said she first learned to speak Spanish and then once she started speaking English, she didn't know how to spell any words in Spanish. I asked if she learned how to spell in English first and she said yes. I realized several important things from this conversation. Most importantly, Juana was never literate in Spanish. She had to learn English and literacy at the same time. Also, Juana's BICS were much higher than I had anticipated. Three, she had a significant lisp when she spoke.

The second important conversation I had with Juana occurred one week after we finished our Measurement unit in science. She came into the classroom during lunch recess and told me she had something to show me. She went to her backpack and pulled out a glasses case. She told me she hadn't shown me before because she was "too nervous." Shocked, I asked her if she had had them for a while and she nodded. I asked her where they had been and she replied nonchalantly, "at home." I asked her if she could see well without them and she said she could. I looked through them and saw that the prescription was pretty strong, which told me that, in fact, she could not see well

without them. I asked if she had been embarrassed for the class to see her with glasses and she nodded. I told her how much I liked them and she put them on for me. We then tried to think of all the students in our class and some of the school staff with glasses and agreed that they all look great. I asked if we could share her glasses with the class together in order for her to feel more comfortable and she said agreed it would be helpful. However, the glasses mysteriously broke the day after Juana showed them to me and she said she had to wait several months to get new ones.

Discussion. After observing both of these students more closely, I began to realize that there were more layers affecting them than simply their levels of science CALP. In Elias's case, the observations lead to two discoveries. One was that Elias is an auditory learner. I finally started to put this together after reading my coworker's observation notes. When she observed Elias, he was making entries into his dictionary as part of a whole group lesson. In her notes, she stated that he was, "repeating the words quietly to himself," and "touching his lips." These are indications of an auditory learning style. In addition, I found that he would often ask me what a set of written directions said instead of reading them to himself. Or, he would repeat part of what he heard in order to confirm what he needed to do. Both of these could easily be considered signs of an auditory learning preference. Another discovery was that Elias is interested and willing to participate if he received very specific, single-step directions from the teacher and/or if there is an activity involving movement where he can interact with his peers. I would also consider him an extrovert. Purpura (2014) discusses the importance of considering different learning styles when working with language learners. He categorizes auditory

learning as a perceptual preference. He also considers introversion vs. extroversion as a personality preference (p. 534-537). Clearly, in order for Elias to effectively learn, his learning preferences must be tapped into, as with any other student. What I had not previously considered was how his learning preferences might affect his ability to learn new science vocabulary to begin with. Thus, there is hurdle that precedes the acquisition of his science CALP.

Juana's situation also turned out to be much more complex than I had originally anticipated. Through my observations, I saw that she was very self-conscious. The way she continuously shoved her work in her desk as soon as she was finished told me she was trying to avoid others looking at it. Her desire to arrive last to her group showed that she was uncomfortable working with her classmates and likely self-conscious of talking to them. However, it was not until Juana had those two important conversations with me that I truly began to understand what was affecting her as a learner. First, I learned that she was never literate in Spanish, her first language. This means that she entered kindergarten at an extreme disadvantage compared to her native English-speaking peers. To begin with, most if not all of these students had developed a fairly extensive English vocabulary. Additionally, many had undoubtedly gained pre literacy skills either through early childhood education or from their parents. Juana was introduced to both of these incredibly complex skill sets at the same time. Also, our ELL Specialist has since confirmed that Juana's family speaks only Spanish at home. Because of all this, I have to assume that Juana has essentially been trying to catch up to the abilities of her native English-speaking peers since her first day of kindergarten. Freeman & Freeman (2007)

make it a point to remind teachers that, “All the students need support to succeed in studying academic content in English, but they come to school with different backgrounds including different educational preparation in their first languages” (30). I read this book while conducting my research so this particular section helped me to better understand the significance of Juana’s experience.

The other conversation I had with Juana revealed two additional pieces of information. One is that Juana’s vision is extremely poor without her glasses. She had not worn them all year and I can only imagine how greatly her inability to see well has affected every area of her learning. I thought she might also be an auditory learner but realized perhaps she had just been relying on her auditory skills because her vision had been impaired. And, since she was so uncomfortable with wearing them at this school, I wondered if she had ever been comfortable wearing them to any school. The fact that this child would rather go through the day practically blind than be seen in glasses by her classmates told me just how self-conscious she really was. Not to mention the fact that it took her nearly five months to say more than a couple of words to me. In this case, it is clear that Juana’s poor vision and affective filter greatly impacted her ability to acquire language. Brown (2006), who is an expert in teaching and learning English as a second language, remarks,

Brown (2006) “The affective domain includes many factors: empathy, self-esteem, extroversion inhibition, imitation, anxiety, attitudes—the list could go on. Some of these may seem at first rather far removed from language learning, but

when we consider the pervasive nature of language, any affective factor can conceivably be relevant to second language learning” (p. 64).

Like Elias, Juana’s difficulties lie deeper than simply needing to learn content vocabulary.

Assessments

Results. On the English as an Additional Language (EAL) Listening & Speaking Continuum (Campbell Hill, 2001), Juana was placed in the “Becoming Competent” category by our school’s ELL Specialist during the time of this study. She was beginning to communicate some with students and staff members which included expressing needs and wants. She had also begun to ask questions in the correct format. Additionally, she proved that she was able to understand some content-specific instruction with repetition and rephrasing.

In contrast, Elias was primarily placed in the “Becoming Fluent” category, while also displaying some characteristics of the “Fluent” category. He was able to demonstrate many skills of a proficient English speaker. He showed that he could listen attentively to a native speaker as well as listen and respond appropriately to his peers. He also demonstrated that he could speak nearly as fluently as a native English speaker and that if he made any errors, they did not detract from his communication.

On the Measurement – Content Assessment, Juana scored 13 out of a possible 20 points. Out of 16 questions, she answered nine correctly (see Table 1). This gave her an overall “2” according to the Content Assessment Scoring Guide, which is considered to be “approaching standard” for third grade. Juana missed nearly all questions directly

pertaining to vocabulary. However, she was able to correctly sequence mm, cm, m, and km from smallest to largest. For the questions which provided images to label and/or interpret, she answered all but one correctly.

On his Measurement – Content Assessment, Elias scored 16 out of a possible 20 points. Out of 16 questions, he answered 12 ½ correctly (see Table 1). This gave him an overall “3” according to the Content Assessment Scoring Guide, which places him at “meets standard” for third grade. Generally speaking, Elias’s few mistakes pertained to applying the correct unit of measurement in a given situation. Additionally, he was unable to correctly order mm, cm, m, and km from smallest to largest.

Discussion. With regards to the EAL Listening & Speaking Continuum (Campbell Hill, 2001), it is important to note that the observation for the assessment did not take place during a science lesson due to scheduling conflicts. While I do think that the continuum gives a snapshot of a student’s levels of English proficiency in terms of both CALP and BICS, it merely shows skills that a student has exhibited at least once. It is a good way to measure overall progress for a student, but not for individual content areas. What I learned was that it would have been better to have the ELL Specialist observe and assess students during science. I realized that some of the ratings she gave were not necessarily the same as what my co-worker and I observed during science lessons. Juana’s results were similar to where I would have placed her during a science lesson. However, there were several areas of Elias’s placement that I have not observed during science. The first was, “Speaks confidently and uses new vocabulary flexibly,” as I did not observe Elias using new science vocabulary flexibly. The second was,

Table 1			
<i>Measurement – Common Assessment Results</i>			
Responses to Assessment Questions			
<u>Test Item</u>	<u>Juana</u>	<u>Elias</u>	<u>Scoring Guide</u>
1	c. 10	b. 100	b. 100
2	b. 100	a. 1,000	a. 1,000
3	d. Add more mass pieces	d. Add more mass pieces	d. Add more mass pieces
4	b. 2cm	b. 2cm	c. 2m
5	km, m, cm, mm	m, cm, km, mm	mm, cm, m, km
6	centimeter	meter	millimeter
7	millimeter	milliliter	milliliter
8	liter	gram	gram
9	degrees Celsius	degrees Celsius	degrees Celsius
10	<i>Drawing shows 20° C</i>	<i>Drawing shows 25° C</i>	<i>Drawing shows 18-26° C</i>
11	<i>vol. & capacity labeled</i>	<i>vol. & capacity labeled</i>	<i>vol. & capacity labeled</i>
12	25	27ml	28ml
13	57g	57g	57g
14	6 ½ cm	6 ½ cm	6 ½ cm
15	#1	0° C	#1 or 0° C
16	#4	100° C	#4 or 100° C

“Understands classroom and subject area language at nearly normal speed.” From what I have observed, Elias takes significantly more time than his classmates to understand academic science language. Last was, “Asks questions to clarify content and meaning,” which I also have not observed during science. The questions Elias asked during science were almost always to clarify directions and procedures. He was much more concerned about what he was expected to do rather than the meaning behind it.

Concerning the Measurement – Common Assessment, I noticed that both students performed well on the portion that contained images for them to interpret and respond to. Each of these questions were directly related to experiments we had conducted and discussed as a class. What I took from this information was that the interactive portion of the Measurement unit was highly impactful to both students and allowed them both to apply what they had learned to new situations on the test. With regards to vocabulary, Elias seemed to have a better understanding in general. However, both students struggled to some degree with the conceptualization of the measurement vocabulary. For example, both students answered that the height of a teacher would best closest to “2 cm,” rather than “2 m.” Especially for Juana, there seemed to be some confusion as to what the various units of measurement actually signified. This also included when to apply the correct standard units of measurement, such as degrees Celsius for measuring temperature, meters for measuring distance or length, liters for measuring capacity, and grams for measuring mass.

Interviews

Unfortunately, I was unable to interview my students until after we had completed our Measurement unit due to time constraints. At this point, we had started our next science unit about the human body. For this reason, some of the students' responses were irrelevant. However, it was interesting for me to hear their perspectives and gain a little more background information from them. Both interviews were under seven minutes in length and both students used short responses, typically consisting of one or two words with an occasional phrase of three or more words.

Results and Discussion for Juana. Juana's interview was the shorter of the two. I started by asking her when her family moved to the United States. She answered that she didn't know, so I asked if she was born here. At first, she responded, "I was born somewhere but I don't know how to say it." When I asked if she meant the United States or a different country, she said, "United States." This was interesting to me because when I asked her a few months ago, she said she had been born in Mexico. The ELL Specialist confirmed that she had been told the same thing. This leads me to believe that Juana might still be confused about the meaning of the word *country*, which is actually not uncommon compared to her third grade peers. Juana then confirmed that her family only speaks Spanish at home which lead me to consider the clear separation between her world at home and her world at school. There is little to no crossover: Spanish stays at home and English stays at school. When Juana first arrived in my classroom, I tried speaking with her in Spanish off and on over the first few days. Each time, she would blush, try to hide a smile, and look away. She would only respond by nodding. At the

time, I thought she was just reacting to the fact that my Spanish is a bit rusty. This could be part of the reason, but her interview response makes me think that perhaps I had attempted to merge her two worlds that have remained mutually separate from one another. I will never know for sure, but I have to wonder if Juana was discouraged from bringing her native language and culture into the classroom at some point.

The second portion of Juana's interview revealed information more specific to learning science. First, she indicated that she had never been introduced to science in school before this year. I was surprised by this because I had previously been told she started kindergarten at a school in Washington. Unless she attended a private school, she should have received science instruction in earlier grades. The other possibility is that she could have missed portions of school in previous grades due to moving or helping out family. It is still unknown what Juana's father does for work but she later told me that her mother stays home with her very young siblings and that Juana often helps out as a caretaker for them. It is possible that she missed science instruction when she was younger while staying home to help her mother.

In the final portion of the interview, Juana told me more about her feelings towards science and what she had learned. When I asked her what she liked about science, she replied, "that you measure, like, people or something else." At the time of the interview, we had already begun our new science unit on the human body so I had not expected her to comment on something she had learned previously. The fact that she brought up something she liked from our Measurement unit told me that it had somehow resonated with her and she had internalized part of what she learned from it. I then asked

her if it was helpful for her to have the class cognitive dictionary and other visual aids up around the classroom to which she responded, “yes.” These responses seemed to indicate that explicit scientific vocabulary instruction was, to some extent, impactful to Juana’s learning. Even if it only made a minor contribution towards her success, I would consider explicit vocabulary instruction to be an important component to include in my science instruction as it is undoubtedly helpful to the rest of my students, too.

Results and Discussion for Elias. My interview with Elias was much different than my interview with Juana. It was here that I could really see how high Elias’s BICS are and how much more confident he was with English in general. While he made a few minor errors typical of an ELL student, he was nearly able to listen and respond with the timing and fluency of a native English speaker. Many of his answers were short but he was willing to use longer phrases and explanations as the need arose.

In the first portion of the interview, Elias provided me with more information about his background. He had told me earlier in the year that he was originally born in Texas. During the interview, he said that his family moved to the United States, “When I was three years old.” I was able to later confirm that he was born in Texas so either his family moved out of the country for a while after he was born or, like Juana, he was confusing *country* with *state*. He also confirmed that he has been attending school within the state, “It’s in this place...it’s an American place,” since kindergarten. He was able to tell me the name of both the elementary school and the city in which it was located by using complete sentences. Additionally, Elias stated that he spoke both English and “Ethiopian” at home. “Like, I speak Ethiopian more like-first I speak American, then I

speak Ethiopian...like...it's...it's back and forth.” Unlike Juana, Elias experienced a co-mingling of his home and school cultures where both were supported and validated.

In the second part of the interview, Elias and I discussed his experiences with science in school. When I asked him to think back to when he first started studying science in school, he was able to remember back to first grade. This made sense to me, especially if he attended the same public school within the state up until last year. Also, Elias's overall comfort and engagement with science seemed to indicate he had previously received some sort of formal science instruction. He also told me he was able to understand “some” of the vocabulary words we studied in science, which is what I would have guessed based on my observations. Again, this could very well be due to his previous exposure to academic vocabulary in science from previous years.

When I asked Elias to tell me about something he learned about this year in science, he looked a bit overwhelmed at first. Then, he said, “I learned about...mmm...like, lots of things!” True to form, he needed me to ask him more specific questions in order to provide an answer. When I asked what we had learned about earlier that day, he said, “The human body,” then proceeded to describe an experiment we had conducted earlier that day. While this did not pertain to our Measurement unit, I was more interested in the way he responded to my question. I noted that, while he was able to explain both the experiment and a general understanding of its purpose, he never used scientific vocabulary. This could be due to the context of our conversation, as I did not use scientific vocabulary myself. Or, it could be that he

does not know the vocabulary well enough to use it flexibly. My hunch was the latter of the two which told me that he still needed explicit vocabulary instruction in science.

Recommendations

Of the two students, Juana was the one who I felt needed the most immediate set of interventions. The first step would be to have her eyes checked by our school nurse to confirm her poor vision as this immediately affecting most if not everything she does. Assuming that happens, I would ask the nurse to send home a notification to Juana's parents in Spanish regarding the results. If the results confirm Juana's need for glasses, I would ask that the nurse specify that in her notification. I might also ask the ELL Specialist to make a follow-up call in Spanish if Juana keeps showing up without glasses. Next, I would recommend that the ELL Specialist work on building scientific content vocabulary with Juana's third grade group during Lunch Bunch. I would recommend an approach similar to that of Carlo et al. (2004), in which the students not only learn current vocabulary but also important skills to apply when encountering new, unknown words. Juana clearly needs the extra exposure and practice. Also, knowing how self-conscious she is, Juana would likely do best in a small group setting with other native Spanish speakers. I believe it would boost her confidence and help her to feel more comfortable. Additionally, I would contact our school's Speech Therapist to let her know about Juana's lisp. I am not sure if she would qualify for Speech, but I feel that the one-on-one time would be a safe space for her to build confidence through practicing speaking. I would like to see Juana's confidence build as she receives services that are specific to her learning needs. Next, I would recommend that Juana spends time reading at home. At

this point, she seems more comfortable reading in English than Spanish but either would be good for practicing and strengthening her literacy skills. Finally, I would reach out to Juana's family, possibly through a translator, in the hopes of forming a deeper relationship between Juana's home and school.

Elias is clearly the stronger of the two students in terms of overall English proficiency. His BICS are close to that of a native English speaker, which is very positive. He still needs support in terms of CALP, but there is more to consider than simply extra vocabulary instruction. What is difficult about Elias's situation is that he still needs ELL support but no longer qualifies for ELL services, so it must be up to the general education classroom teacher to provide it for him. Because of this, I would recommend that Elias be put on a slightly different homework plan than the native English speakers in his class. This would include shortening some assignments (such as nightly math homework) and adding some homework from other content areas such as science. I would keep the assignments short but choose one area to focus on so that Elias could practice throughout the week. Since he enjoys active participation and is an extrovert, I would try to include short games and activities to do with friends or family members. An example could be as simple as adding a science vocabulary matching game to his weekly homework. Since his family is so supportive, I imagine they would be very helpful in reinforcing this with him. I would also recommend including him in some sort of group at school similar to the Lunch Bunch that Juana belongs to. This could easily meet his learning styles and preferences in terms of being both an auditory learner as well as an extrovert. Again, he does not qualify for ELL services so it might have to be done

by the teacher. He could benefit from explicit vocabulary instruction such as that created by Carlo et al. (2004), however it would need to be interactive and fun for him in order for it to be effective, as his affective filter is as important to consider as Juana's.

Conclusion

In the end, I did find that academic science vocabulary was affecting my two ELL students' abilities to master third grade science concepts, but not in the way I had originally assumed. What I discovered was that the obstacles to learning they both faced were deeper than the ability to acquire new vocabulary. Juana has endured several misfortunes that have deeply impacted her ability to learn in general. This included starting school in kindergarten with no knowledge of English, starting kindergarten with no literacy or pre-literacy instruction, having very poor eyesight and not wearing glasses, and being incredibly shy and self-conscious. With all of these factors in play, it is certainly not surprising that her science CALP is low or that she is not meeting grade level expectations in science. In fact, after learning all of this, it was surprising to me that she was doing as well as she was.

For Elias, his ability to learn was greatly impacted by his affective filter. He was able to learn academic science vocabulary when his learning preferences were met. He needed fun, interactive activities that catered to his extroversion. Additionally, he benefitted most from information that was presented or enforced verbally as it met his auditory needs. Finally, he needed clear, concise instruction in order to be most successful. It appears that when these needs were met, Elias was able to learn and

acquire new science vocabulary and skills, as he met grade level expectation on his Measurement – Content Assessment.

From this study, I have also learned valuable information that will direct my practice as a teacher going forward. Most importantly, I realized how important it is not to make any assumptions about students, regardless of whether or not they are ELLs. Juana's case is a great example of this, as I very wrongly assumed that her main hurdle in science was the fact that she was not receiving enough academic vocabulary instruction. Clearly, her impediments were much more deeply rooted and complicated. Secondly, I came to more fully understand the impact that a student's affective filter plays in his or her ability to learn anything, let alone in a second language. I had been so focused on the fact that they were ELL students that I forgot to take a step back and think about elements outside of language that might be influencing them. As a trained and practicing teacher, these should have been some of the first aspects to consider. Now I know to dive deeper with my ELL students to gain a better understanding of them as individuals first. Third, I learned that explicitly teaching academic content vocabulary is important but that it must cater to students' learning preferences. The cognitive content dictionary we completed as a class during the Measurement unit was a great tool that I would use again. During instruction, it met the needs of all learning styles, was scaffolded, and was a helpful tool that students referred to throughout the unit. Finally, I saw the importance that an ELL student's community plays in his or her success. In the future, I will continue to pursue close relationships with staff and students' families to try to make sure that there is a strong home-school connection to reinforce the structure of a full support system.

References

- August, D., Carlo, M., Dressler, C., & Snow, C. (2005). The Critical Role of Vocabulary Development for English Language Learners. *Learning Disabilities Research & Practice, 20* (1), 50–57
- Beck, I., McKeown, M. G., & Omanson, R. C. (1987). The effects and uses of diverse vocabulary instructional techniques. In M. G. McKeown & M. E. Curtis (Eds.), *The nature of vocabulary acquisition* (pp. 147-163). Hillsdale, NJ: Erlbaum.
- Brown, D. H. (2006). *Principles of Language Learning and Teaching* (5th ed.). New York: Pearson Education ESL.
- Campbell Hill, B. (2001). *Developmental Continuums: A Framework for Literacy Instruction and Assessment K-8* (2nd ed.). Norwood, MA: Christopher-Gordon Pub.
- Carlo, M. S., August, D., Mclaughlin, A., Snow, C. E., Dressler, C., Lippman, D. N... (Apr. – Jun., 2004). Closing the Gap: Addressing the Vocabulary Needs of English-Language Learners in Bilingual and Mainstream Classrooms. *Reading Research Quarterly, 39* (2), 188-215.
- Cummins, J. (Jun., 1980). The Cross-Lingual Dimensions of Language Proficiency: Implications for Bilingual Education and the Optimal Age Issue. *TESOL Quarterly, 14* (2), 175-187.
- Cunningham, J.W., & Moore, D.W. (1993). The Contribution of Understanding Academic Vocabulary to Answering Comprehension Questions. *Journal of Literacy Research, 25* (2), 171-180.

- De la Colina, M. G., & Cuellar, R. (2011). Academic Spanish in a Science Bilingual Classroom: It's not Just About Words.... *National Forum Of Applied Educational Research Journal*, 25(1/2), 29-43.
- Diversity Toolkit: English Language Learners (ELLs). (n.d., para 1). In *National Education Association: Tools and Ideas*. Retrieved from <http://www.nea.org/tools/30405.htm#S>
- Fradd, S.H., & Lee, O. (Aug. - Sep., 1999). Teachers' Roles in Promoting Science Inquiry with Students from Diverse Language Backgrounds. *Educational Researcher*, 28 (6), 14-20 + 42.
- Freeman, D., & Freeman, Y. (2007) *English Language Learners: The Essential Guide*. Scholastic Teaching Resources.
- McKeown, M. G., Beck, I.L., Omanson, R.C., & Pople, M. T. (Autumn, 1985). Some Effects of the Nature and Frequency of Vocabulary Instruction on the Knowledge and Use of Words. *Reading Research Quarterly*, 20 (5), 522-535.
- Purpura, J. E. (2014). Language Learner Strategies and Styles. In M. Celce-Murcia Editor, D. M. Brinton Editor, & M. A. Snow Editor (Eds.), *Teaching English as a Second or Foreign Language* (4th ed.) (pp. 532-549). Boston, MA: National Geographic Learning.
- Richards, J.C. (Mar., 1976). The Role of Vocabulary Teaching. *TESOL Quarterly*, 10 (1), 77-89.

Young, E. (2005). THE LANGUAGE OF SCIENCE, THE LANGUAGE OF
STUDENTS: Bridging the Gap with Engaged Learning Vocabulary
Strategies. *Science Activities*, 42(2), 12-17.

Appendix A

Measurement – Content Assessment

Name _____

Date _____

Measurement – Content Assessment

Each student will need a ruler.

Circle the letter of the best answer:

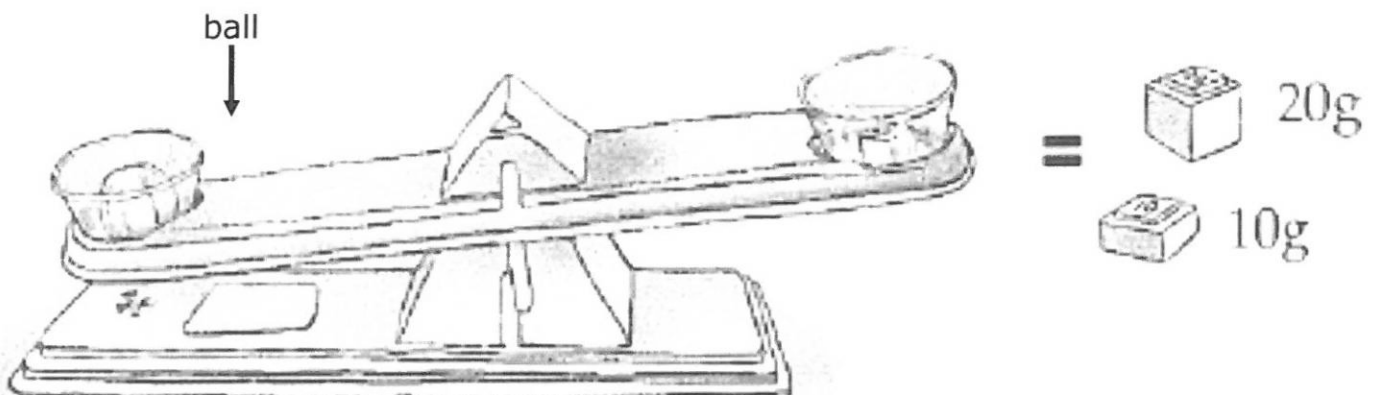
1. How many centimeters are in 1 meter?

- a. 1000
- b. 100
- c. 10
- d. 1

2. How many milliliters are in 1 liter?

- a. 1000
- b. 100
- c. 10
- d. 1

3. Using the picture below, what do you need to do to find the correct mass of the ball?



- a. Take the ball out of the cup
 - b. Take away some of the mass pieces
 - c. Count the mass pieces already there
 - d. Add more mass pieces
4. The height of my teacher is closest to
- a. 2 mm
 - b. 2 cm
 - c. 2 m
5. Put these units in order, **from smallest to largest**.

meter

centimeter

kilometer

millimeter

Directions: Circle the best unit to use for measuring each item.

6. Thickness of a dime:

millimeter

centimeter

meter

kilometer

7. Volume of hot chocolate in a cup:

meter

gram

milliliter

degree Celsius

8. Mass of a paper cup:

meter

gram

liter

degree Celsius

9. Temperature of a glass of lemonade:

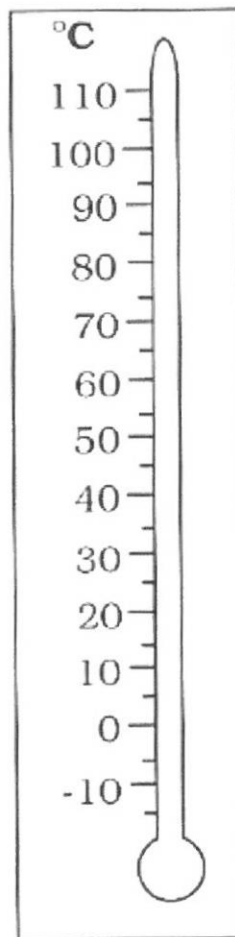
liter

gram

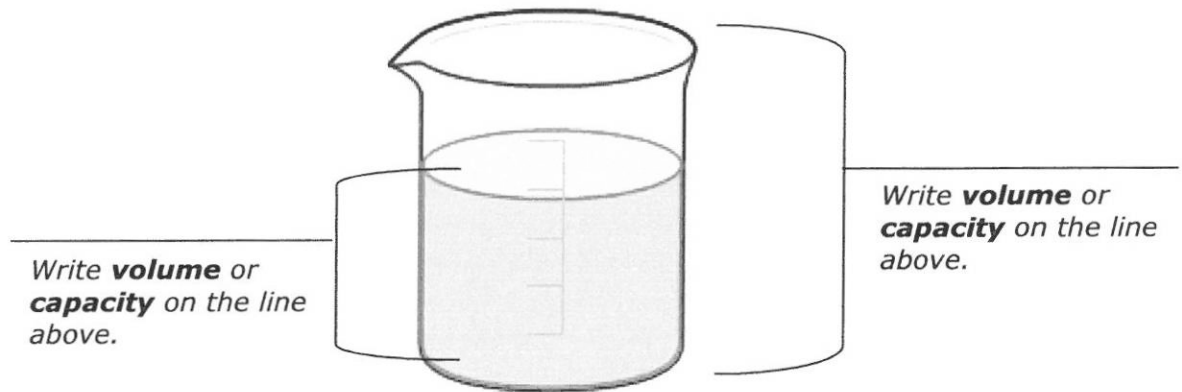
centimeter

degree Celsius

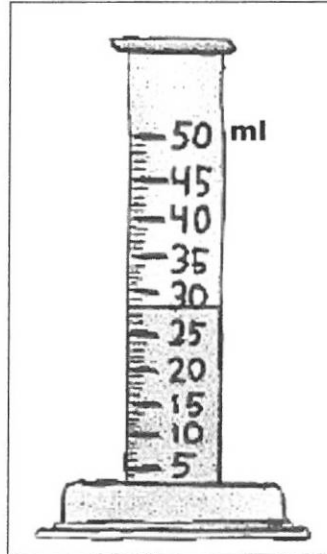
10. Color in the thermometer
to show the temperature of
a comfortable room.



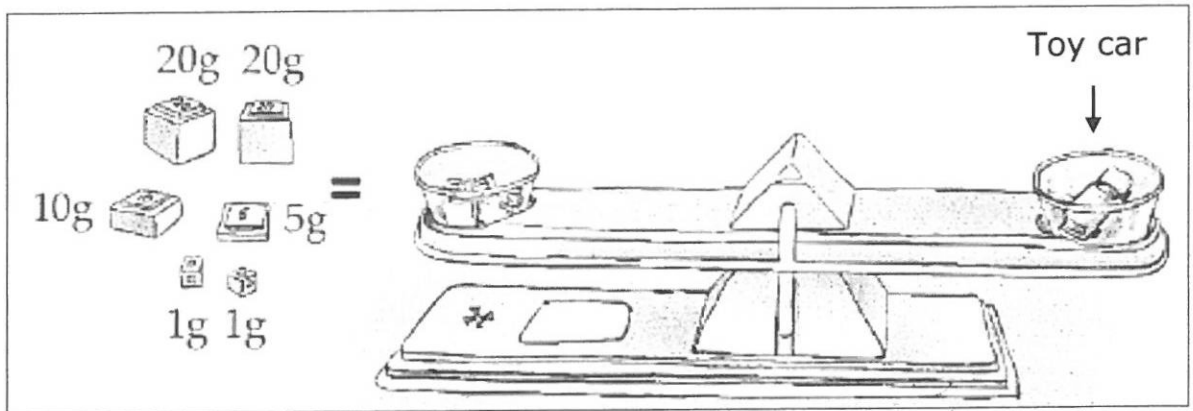
11. Label **volume** and **capacity** on the picture below.



Directions: Look at the pictures below. Record the measurement on the line below each picture.



12. Measurement of water _____



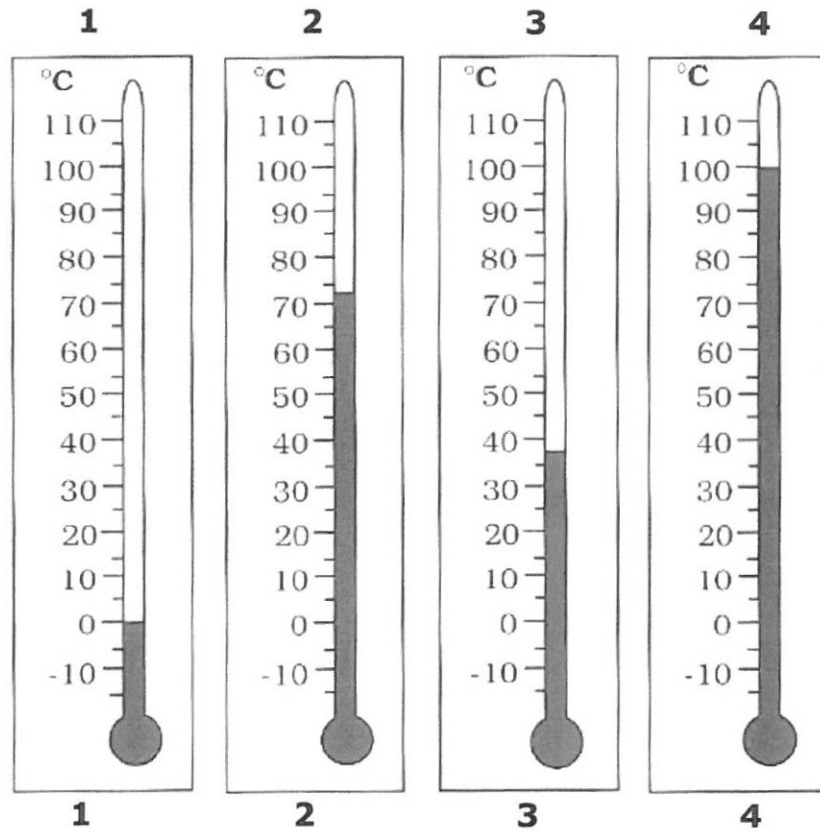
13. Measurement of toy car _____

14. Using a ruler, measure the object below and record your measurement in centimeters.



The length of the nail is _____

Directions: The thermometers, numbered 1-4 below, show different temperatures.



Write the number of the thermometer that shows:

15. The temperature at which water freezes _____
16. The temperature at which water boils _____

Appendix B

Content Assessment Scoring Guide

Content Assessment Scoring Guide: Measurement – 20 points

#	Points	Correct response:
1.	1	b. 100
2.	1	a. 1000
3.	1	d. Add more mass pieces
4.	1	c. 2 m
5.	1	millimeter, centimeter, meter, and kilometer
6.	1	millimeter
7.	1	milliliter
8.	1	gram
9.	1	degree Celsius
10.	2	2 points if student colors in the thermometer to show a temperature between 18°C and 26°C 1 point if student colors in the thermometer to show a temperature between 15°C and 30°C (but not 18°C - 26°C)
11.	1	volume on the left line, capacity on the right line
12.	2	2 points if student writes correct numerical value and unit (28 ml) 1 point if only the numerical value or unit is correct
13.	2	2 points if student writes correct numerical value and unit (57 g) 1 point if only the numerical value or unit is correct
14.	2	2 points if student writes correct numerical value and unit (6 cm ± 2 mm) Teachers should measure one copy of the actual test to verify measurement due to copy machine issues. 1 point if only the numerical value or unit is correct
15.	1	#1 or 0°C
16.	1	#4 or 100 °C

Scoring Conversion for Measurement

Range of Points	Score	Description
19-20	4	Exceeds standard
15-18	3	Meets standard
11-14	2	Approaching standard
0-10	1	Well below standard

Appendix C

ELL & Science: Interview Questions

ELL and Science: Interview Questions

1. When did your family move to the United States?
2. What language do you speak at home?
3. How old were you when you first started learning English?
4. Have you learned about science in school before?
5. Did you learn about science in another language?
6. What do you like about science?
7. What do you dislike about science?
8. How well do you understand the vocabulary words we use in our classroom during science?

a. I understand a little or none



b. I understand some



c. I understand most or all



9. What is something you learned about in science this year?
10. What is something you learned about in science today or this week?
11. Is there anything that was confusing to you today or this week in science?

Appendix D

EAL Listening & Speaking Continuum

English as an Additional Language (EAL) Listening & Speaking Continuum		
New to English	Early Acquisition	Becoming Familiar
<p>Becoming Competent</p> <ul style="list-style-type: none"> 1. Listens attentively to an English speaker with guidance 2. Follows one-step directions 3. Uses context cues to respond appropriately to classroom routines 4. Responds to greetings with nods and gestures 5. Responds to simple questions with guidance 6. Expresses needs in English with single words and gestures 7. Responds during classroom discussions with nods and gestures 8. Participates non-verbally in the classroom 9. Names simple objects with guidance 10. Repeats English words and phrases with guidance 11. Echoes single words and/or short phrases 12. Produces single words and/or short phrases with guidance 13. Demonstrates enthusiasm about hearing English. 	<p>Becoming Fluent</p> <ul style="list-style-type: none"> 1. Begins to follow illustrated stories and classroom instruction 2. Follows two-step directions 3. Responds to greetings with single words and/or phrases 4. Begins to respond to simple questions with one-word answers 5. Begins to express needs and give basic information (e.g. 'I'm fine' and 'this car') 6. Participates orally in classroom discussions with guidance 7. Uses some basic classroom vocabulary 8. Understands everyday classroom and subject area language with guidance 9. Begins to repeat new English words and phrases clearly 10. Begins to communicate using short phrases and simple language patterns, producing telegraphic sentences (e.g. 'I want to go shop buy toy') 11. Practices English and tries new words and phrases 	<p>Fluent</p> <ul style="list-style-type: none"> 1. Begins to listen attentively to an English speaker 2. Follows multi-step directions 3. Begins to use English in social situations 4. Responds to greetings with phrases 5. Responds to simple questions with more than one-word answers 6. Uses different language functions in discussions (e.g. predicting and describing) with guidance 7. Participates in classroom discussions and offers opinions and feedback with guidance 8. Begins to understand classroom and subject area language 9. Begins to use expanding vocabulary that is less context-bound 10. Begins to speak English clearly 11. Communicates using short phrases and simple language patterns 12. Begins to use connected discourse (e.g. 'Yesterday I go pool and I swim')
<p>Becoming Competent</p> <ul style="list-style-type: none"> 1. Begins to contribute to group discussions and offer opinions and/or feedback during discussions 2. Paraphrases oral information with guidance 3. Uses English in social situations 4. Begins to respond to more complex questions 5. Expresses needs and give information independently 6. Begins to ask questions to clarify content and meaning 7. Begins to use more complex language functions (e.g. hypothesizing and reasoning) within an academic context 8. Begins to use an extensive vocabulary, using some abstract and specialized subject area words 9. Understands classroom and subject area language with repetition, rephrasing, or clarification 10. Speaks English clearly 11. Produces longer, more complex utterances using phrases, clauses, and sequence words (e.g. 'next' and 'then') 12. Begins to use correct form when asking questions 13. Begins to use correct verb tense to express present, past, and future 14. Shows interest in improving language skills and accuracy. 	<p>Becoming Fluent</p> <ul style="list-style-type: none"> 1. Listens attentively to an English speaker 2. Listens to others and offers opinions and/or feedback 3. Begins to paraphrase oral information 4. Uses language appropriately across the curriculum for different purposes and audiences 5. Responds to complex questions independently 6. Asks questions to clarify content and meaning 7. Shows awareness that there are appropriate forms and styles of language for different purposes and audiences 8. Begins to speak with confidence in front of a group 9. Uses more extensive vocabulary, using abstract and specialized subject area words independently 10. Understands classroom and subject area language at nearly normal speed 11. Speaks English with near-native fluency; any hesitation does not interfere with communication 12. Begins to vary speech appropriately using intonation, stress 13. Uses correct form when asking questions 14. Speaks confidently and uses new vocabulary flexibly. 	<p>Fluent</p> <ul style="list-style-type: none"> 1. Contributes to group discussion with ideas and appropriate suggestions 2. Paraphrases oral information independently 3. Communicates competently in social and academic settings 4. Participates and performs competently in all subject areas 5. Employs a full range of language functions independently, using abstract and complex language to express ideas and opinions appropriate to age 6. Speaks with confidence in front of a group 7. Understands a wide range of classroom and subject area language with native competence 8. Uses vocabulary, approximating that of a native speaker 9. Speaks as fluently as a native speaker 10. Varies speech appropriately using intonation and stress independently 11. Uses a wide range of language patterns and complex compound sentences to create properly connected discourse (e.g. 'Tomorrow I will be going on a long trip and I will see my good friend')

Developmental Continuum

Listening and Comprehension

Oral Expression

Vocabulary

Pronunciation and Fluency

Grammar

Attitude

Appendix E

My Measurement Dictionary

Word (English)	Word (Other)	Prediction	Definition/Drawing	Sentence
measurement				
standard				
length				

width				
meter				
centimeter				
kilometer				

distance				
estimate				
arm span				
height				

comparison				
balance				
fulcrum				
gram				

mass				
kilogram				
volume				
capacity				

liter				
milliliter				
graduated cylinder				
syringe				

temperature				
degrees Celsius				
thermometer				